

RESPONSE OF NAVEL ORANGEWORM AND INDIANMEAL MOTH EGGS TO LOW TEMPERATURE STORAGE

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Dried fruit and nut processors currently rely on the fumigants methyl bromide and phosphine to disinfest their product of postharvest insects. Various alternative treatment methods have been suggested, including the fumigant sulfuryl fluoride and systems that combine disinfestation treatments with low temperature storage. Insect eggs are relatively tolerant of sulfuryl fluoride, which reduces its utility against common storage insects such as the Indianmeal moth. In combination treatments, low temperature storage serves to protect clean product from reinfestation, rather than disinfecting contaminated product. However, contamination of recently disinfested product with pyralid moth eggs is possible before the product can be moved into cold storage. Preliminary studies indicate that moth eggs are relatively susceptible to low temperatures. The objective of this study is to determine the exposure times and temperatures needed to control eggs of Indianmeal moth (*Plodia interpunctella*) and navel orangeworm (*Amyelois transitella*).

Materials and Methods

The mortality of three different ages of Indianmeal moth (IMM) and navel orangeworm (NOW) eggs at two or three different relative humidities and three different temperatures was tested. Exposure periods ranged from 1 to 12 days, depending upon treatment temperature and insect. Navel orangeworm eggs were treated at 18, 42, and 66 hrs old (± 6 hrs). Indianmeal moth eggs were treated when 9, 30 and 54 hrs old (± 8 hrs). We used walk-in environmental rooms to maintain test temperatures of about 0, 5 and 10°C. Test eggs were placed in sealed plastic shoeboxes. The desired relative humidities (ca. 20 and 80% at 10°C, and 20, 50, and 80% at 5 and 0°C) were obtained by placing flat dishes with the appropriate glycerin solutions within the boxes. Dataloggers were used in each box to monitor both temperature and relative humidity. For each replication, about 200 Indianmeal moth and 100 navel orangeworm eggs were exposed to each treatment combination. After removal from treatment temperatures, eggs were held at 27°C for 10 days before percentage hatch was determined. Tests were replicated at all relative humidities 3-5 times for 10 and 5°C, and twice for 0°C.

Results

The exposure times needed to obtain 95% mortality (LT_{95}) are given in Table 1. At all three treatment temperatures, Indianmeal moth proved more cold tolerant than navel orangeworm. The most cold tolerant eggs were the middle aged eggs (30 ± 8 hrs old) for

Indianmeal moth, and the oldest eggs (66 ± 6 hrs old) of navel orangeworm. Relative humidity seemed to have no significant effect on egg mortality.

Table 1. LT_{95} ¹ (in days) for navel orangeworm and Indianmeal moth eggs exposed to 0, 5 and 10°C at different relative humidities.

Age ²	RH (%)	10°C		5°C		0°C	
		NOW	IMM ³	NOW	IMM	NOW ⁴	IMM
Young	20	7.3	-	4.4	7.4	-	4.4
	50	-	-	4.6	7.5	-	4.2
	80	7.6	-	4.7	7.3	-	4.2
Middle	20	8.3	-	5.4	8.9	1.9	6.3
	50	-	-	5.5	9.5	2.1	7.7
	80	9.0	11.6	5.8	9.8	1.9	6.9
Old	20	8.2	-	6.1	5.4	2.8	3.2
	50	-	-	6.2	5.8	2.6	3.6
	80	9.1	-	7.1	5.9	2.8	3.3

¹ LT_{95} obtained through probit analysis. Data for IMM were transformed using log10.

² Ages defined in Materials and Methods.

³ Data from Johnson et al, 1997; only most cold tolerant age is included.

⁴ Mortality of youngest NOW eggs was nearly complete even at the shortest exposure (1 day).

Conclusions

Our results show that relatively short-term low temperature storage of product containing only pyralid eggs would provide sufficient control. The storage durations needed to obtain 95% mortality decrease with temperature, and are unaffected by relative humidity. Suitable storage times for 10, 5 and 0°C were 12, 10 and 8 days, respectively. Exposure to low temperatures may be a practical means to disinfest relatively clean product briefly exposed to moths. Cold storage shows promise in combination with disinfestation methods such as controlled atmosphere treatments or high temperature dehydration procedures. Cold storage may also be used after treatments to which pyralid eggs are more tolerant, such as sulfuryl fluoride.

References cited:

Johnson, J. A., K. A. Valero, and M. M Hannel. 1997. Effect of low temperature storage on survival and reproduction of Indianmeal moth (Lepidoptera: Pyralidae). Crop Protection. 16: 519-523